

PREFACE

This is the first of a group of publications dealing with the use of sweeteners, and of their competitive position in the various food industries. Later publications are planned that will deal with the competitive use of sweeteners in (1) the manufacture of sweetened dairy products, (2) the confectionery industry, (3) the beverage industry, and (4) the baking industry. A final report summarizing the principal findings for each industry is also planned.

Research, analyzing and evaluating trends in the production, consumption, and competition among sweeteners has been recommended by the Sugar Research and Marketing Advisory Committee.

CONTENTS

	<u>Page</u>
Summary	iv
Introduction	1
Size and location of the industry	2
Quantity of sweeteners used	2
Geographic distribution of the use of sweeteners by the canning industry . .	6
Government regulations of the use of sweeteners by the canning industry	6
Canned fruits	10
Sweeteners permitted in canned fruits	11
Frozen fruits	12
Jams, jellies, and preserves	12
Canned vegetables	12
Industry practices in the use of sweeteners	13
Use of noncaloric sweeteners	14
Forms of sweeteners used	15
Cost of sweeteners relative to other raw materials used by canners	15
Economic implications	16

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SUMMARY

The canning industry (canned, bottled, and frozen foods, jams, jellies, pickles, and preserves) is one of the larger users of sugar and corn sweeteners in the United States. The industry produces a wide range of products, and the type and quantity of sweeteners used in them vary considerably.

Canning plants are widely dispersed geographically. The largest number of plants freezing fruits and vegetables is located in the Pacific Coast States; and the East North Central States have the largest number canning fruits and vegetables and producing pickles and sauces.

The most rapid increase in the output of any major segment of the canning industry since the end of World War II has been in the production of frozen fruits and vegetables. Most frozen fruits contain large quantities of sugar, usually between 15 and 25 percent by weight, the most common quantity being 20 percent.

Since 1952 the use of sweeteners (sugar, dextrose, and corn sirup) in the canning industry has increased at an average rate of about 38,000 tons per year, a gain of about 50 percent. The most rapid increase was in the use of corn sirup more than 100 percent from 1952 through 1961. The use of dextrose fluctuated irregularly during this period and had only a slight upward trend. The use of sugar increased at an average rate of about 31,000 tons per year -- a gain of 49 percent. Cannerymen indicate that relatively lower prices for corn sirup have been an important factor in the more rapid increase in its use instead of sugar.

If these trends in the use of sweeteners by the canning industry continue for the next 5 years, consumption in 1966 will be about 1,182,000 tons. Of this tonnage, 85.3 percent will be sugar; 2.4 percent, dextrose; and 12.3 percent, corn sirup.

Canning plants in the Western States use more sugar than those in any other region of the country. While sugar consumption for canning purposes in this region has been increasing, the rate of increase has been less than that for the rest of the country. The rate of increase in the North Central States has been substantially greater than in any other major region. These changes in sugar consumption reflect changes in the output of the commercial canning industry in different regions of the country.

The overall increase in the use of sweeteners in the industry has been considerably more rapid than the growth of population. This reflects both the gradual transfer of canning from homes to commercial establishments and changes in dietary habits which involve the consumption of more canned or frozen products containing relatively large amounts of sweeteners.

Blends of sugar and corn sirup and of sugar and dextrose have been purchased by canners in increasing amounts in recent years. Further increases in the use of blends during the next few years are anticipated. The use of purchased blends is a logical development from older trends toward the use of sugar in liquid and dry bulk forms. Because of special circumstances, however, such as the need for a sugar of particular quality, some canners prefer to purchase part or all of their sugar in bags.

Although the prices of sugar and other sweeteners have been comparatively stable since sugar quotas were reestablished in 1948, price fluctuations are sufficiently important to cause canners to give careful attention to their buying practices. They are more concerned with purchasing sweeteners at prices no higher than those paid by their competitors than with minor changes in the general level of sweetener prices.

SWEETENERS USED BY FOOD PROCESSING INDUSTRIES IN THE UNITED STATES

THEIR COMPETITIVE POSITION IN THE CANNING INDUSTRY

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INTRODUCTION

The canning industry 1/ is one of the larger users of both sugar and corn sweeteners (principally corn sirup) in the United States. It used about 7.7 percent of the total quantity of sweeteners consumed in the United States in 1952. This increased to 9.6 in 1961. The industry is also an important user of noncaloric sweeteners, but detailed statistics on these uses are not available.

Sweeteners are an essential ingredient of most of the products of the canning industry, except vegetables. They act both as a preservative and as a means of providing desirable flavor and body; in addition to providing a sweet taste, they enhance other desirable flavors in many products.

Changing conditions in the canning industry--particularly with reference to competition among sugar, corn sirup, and other sweeteners--have created a need for more information concerning them and their probable effect on the domestic sugar and corn sweetener industries and on consumers generally. 2/ A previous publication of the U. S. Department of Agriculture contains information of a related nature for an earlier period.

Sugar is still the primary sweetener used by the canning industry, but there is evidence that its position has been weakening slowly since World War II. The extent of this trend and its causes needs investigation and analysis if members of the sugar industry and others are to act in their own best interests. The position of producers of corn sirup differs, of course, from that of sugar producers. However, producers of corn sirup, whose sales to the canning industry have been increasing at a relatively rapid rate, also need accurate information about the problem if they are to act intelligently in their own best interests.

The specific purposes of this report are (1) to determine trends in the quantity of each type of sweetener used, (2) to provide information concerning the problems and practices of various segments of the canning industry in their purchase and use of sweeteners, and (3) to analyze the competition among producers of different sweeteners in selling their products to the canning industry.

1/ In this report, the canning industry includes all commercial establishments engaged in the production of canned, bottled, and frozen foods, jams, jellies, pickles, and preserves.

2/ Jones, P. E., and Thomason, F. G. Competitive Relationships Between Sugar and Corn Sweeteners, Agr. Inf. Bul. No. 48, 245 p., 1951.

Table 3.--Sugar, dextrose, (corn sugar) and corn sirup delivered to the canning industry in the United States, 1952-61 1/

Year	Sugar	Dextrose	Corn sirup	Total	Sugar	Dextrose	Corn sirup	Total
	1,000 tons	1,000 tons	1,000 tons	1,000 tons	Percent	Percent	Percent	Percent
1952.....	548	26	56	630	87.0	4.1	8.9	100.0
1953.....	616	25	59	700	88.0	3.6	8.4	100.0
1954.....	622	24	68	714	87.1	3.4	9.5	100.0
1955.....	652	25	82	759	85.9	3.3	10.8	100.0
1956.....	739	28	82	849	87.0	3.3	9.7	100.0
1957.....	737	26	78	841	87.6	3.1	9.3	100.0
1958.....	751	29	84	864	86.9	3.4	9.7	100.0
1959.....	798	27	100	925	86.3	2.9	10.8	100.0
1960.....	790	27	108	925	85.4	2.9	11.7	100.0
1961.....	855	26	119	1,000	85.5	2.6	11.9	100.0

1/ Dry basis. Sugar, 100.0 percent; dextrose, 92.0 percent; and corn sirup, 80.3 percent; as produced.

Sugar Reports, Sugar Div., Agricultural Stabilization and Conservation Service, U. S. Dept. Agr.

While the total quantity of sugar used by the canning industry increased from 548,000 tons in 1952 to 855,000 tons in 1961, the proportion sugar was of the total sweeteners used by canners declined during the period. This decline has been particularly noticeable since 1957 when it has averaged about 0.5 percent per year, equivalent in 1961 to about 5,000 tons. This quantity, for a single year, is insignificant, but the cumulative effect over a period of years is important, both for the sugar industry and for producers of corn sirup.

The use of sugar and corn sirup by the canning industry has increased considerably faster than the population of the United States since 1952, per capita consumption having risen as shown in table 4. The average annual increase in the per capita consumption of all sweeteners was about 0.28 pound per year. Corn sirup consumption increased about 0.06 pound per year and sugar 0.22 pound.

These per capita increases in sweetener consumption reflect the rapid growth of certain segments of the canning industry. The output of frozen fruits, for instance, increased 74 percent from 1952 through 1961. Relatively large quantities of sweeteners are used in the preparation of frozen fruits, and their production has been increasing nearly 5 times as fast as the population. Also, increases in the production of canned fruits and canned fruit juices have contributed to the increased use of sweeteners by the industry.

The per capita consumption of sugar in households declined somewhat between 1952 and 1962. In part, this appears to have been the result of less home canning and increased purchases of processed food products in recent years. Thus, the increased per capital use of sweeteners in the commercial canning industry has been offset, in considerable part, by declines in household canning.

Table 4.--Per capita consumption of sugar, dextrose (corn sugar) and corn sirup by the canning industry in the United States, 1952-1961 1/

Year	Sugar	Dextrose	Corn sirup	Total
	Pounds	Pounds	Pounds	Pounds
1952.....	6.98	0.33	0.71	8.02
1953.....	7.72	.31	.74	8.77
1954.....	7.66	.29	.84	8.79
1955.....	7.89	.30	.99	9.18
1956.....	8.79	.33	.98	10.10
1957.....	8.61	.30	.91	9.82
1958.....	8.60	.33	.96	9.89
1959.....	9.00	.31	1.13	10.44
1960.....	8.75	.29	1.20	10.24
1961.....	9.32	.28	1.30	10.90

1/ Dry basis. Sugar, 100.0 percent; dextrose, 92.0 percent; and corn sirup, 80.3 percent; as produced.

Sugar Reports, Sugar Div., Agricultural Stabilization and Conservation Service, U. S. Dept. Agr.

The increase in consumption of sweeteners by the canning industry has been at a relatively constant rate since 1952 as indicated in figures 1 and 2. If the straight-line trends shown in these charts are extended for 5 years to 1966, the total indicated consumption of sweeteners by the canning industry is approximately 1,182,000 tons, of which 1,008,000 tons would be sugar; 145 tons, corn sirup; and 29,000 tons, dextrose.

The per capita consumption of sweeteners by the canning industry would approximate 12.3 pounds by 1966 if the trends since 1952, shown in figure 2, should continue. Of the total, about 10.5 pounds would consist of sugar; 1.5 pounds, of corn sirup; and 0.3 pound, dextrose.

Geographic Distribution of the Use of Sweeteners by the Canning Industry

The quantities of both sugar and dextrose delivered to the canning industry in the 12 Western States ^{3/}, as shown in table 5, are larger than those used in any other section of the country. Although data for individual States are not available, deliveries in California undoubtedly were much larger than those in any other State.

However, the increase in the quantity of sugar used in the canning industry in the Western States has been at a somewhat slower rate than that for the rest of the country, so that the proportion used in the area has declined moderately since the early 1950's. The use of dextrose by canners in the Western States declined 39 percent from 1952 to 1961. In 1952 canners in those States used nearly one-half of the dextrose consumed by the industry in the United States; in 1961, less than one-third. The decline in the Western States nearly offset the changes in other areas.

During the period 1952-1961, the most rapid increase in the use of sugar by the canning industry (fig. 3) occurred in the North Central States, followed by that in the Southern States. The rapid increase in the use of sugar in the North Central States, averaging nearly 10 percent per year, was several times that of any other region. At the end of the period, canners in the North Central States were using about the same quantity of dextrose as those in the Western States, compared with about one-third as much in 1952.

The area in which the greatest expansion of the use of dextrose by the canning industry has occurred is also the area in which nearly all the plants producing dextrose in the United States are located. The areas with the most rapid increase in the use of sugar are those where the canning industry, particularly the firms producing frozen fruits, has expanded most rapidly.

GOVERNMENT REGULATIONS OF THE USE OF SWEETENERS BY THE CANNING INDUSTRY

The Food and Drug Administration is the principal agency of the Federal Government regulating the use of sweeteners in commercial food products in the United States. Although some State governments have regulations affecting the use of sweeteners in food products, those of the Food and Drug Administration are, by far, the most influential. Products to which they apply include specified fruits, fruit juices, frozen fruits, preserves, jams, jellies, and canned vegetables.

^{3/} See figure 3 for area boundaries.

USE AND TRENDS in the CANNING INDUSTRY

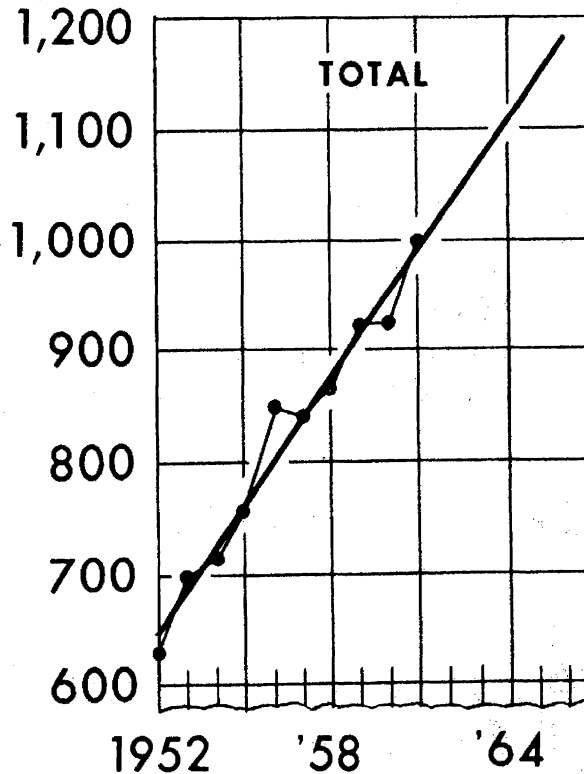
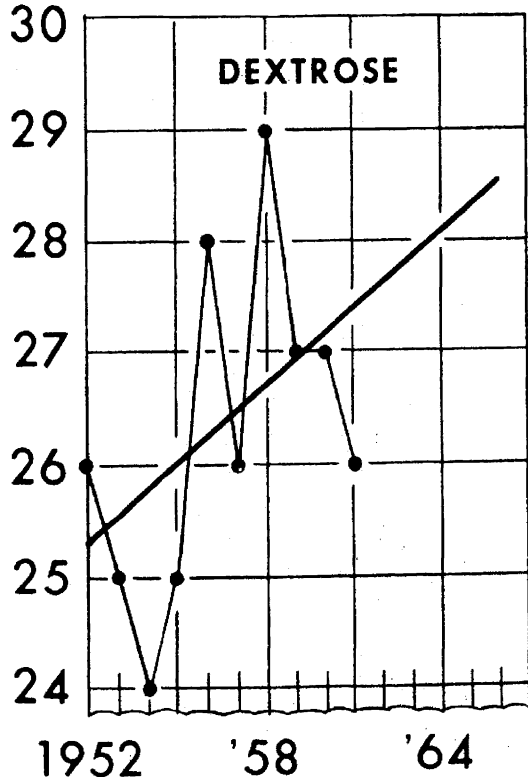
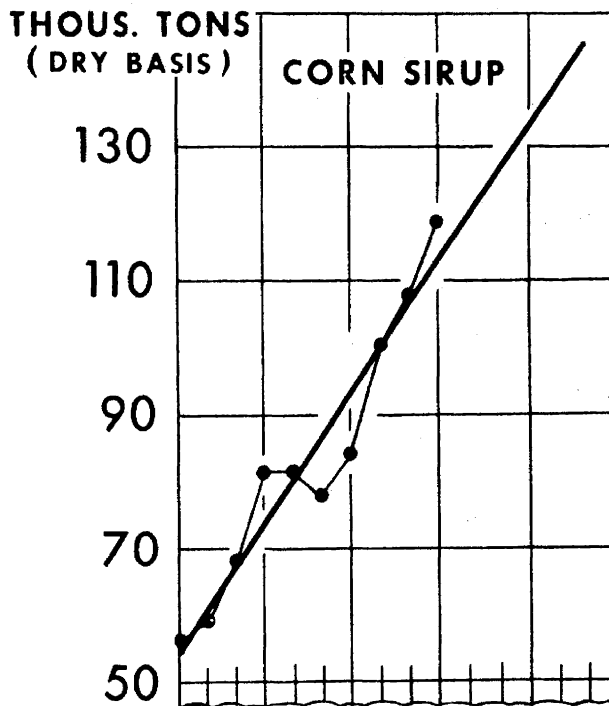
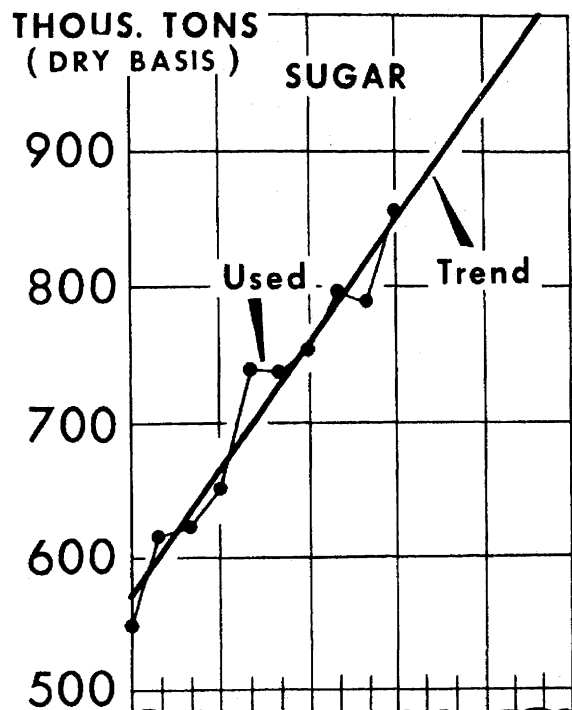


Figure 1

PER CAPITA USE AND TRENDS in the CANNING INDUSTRY

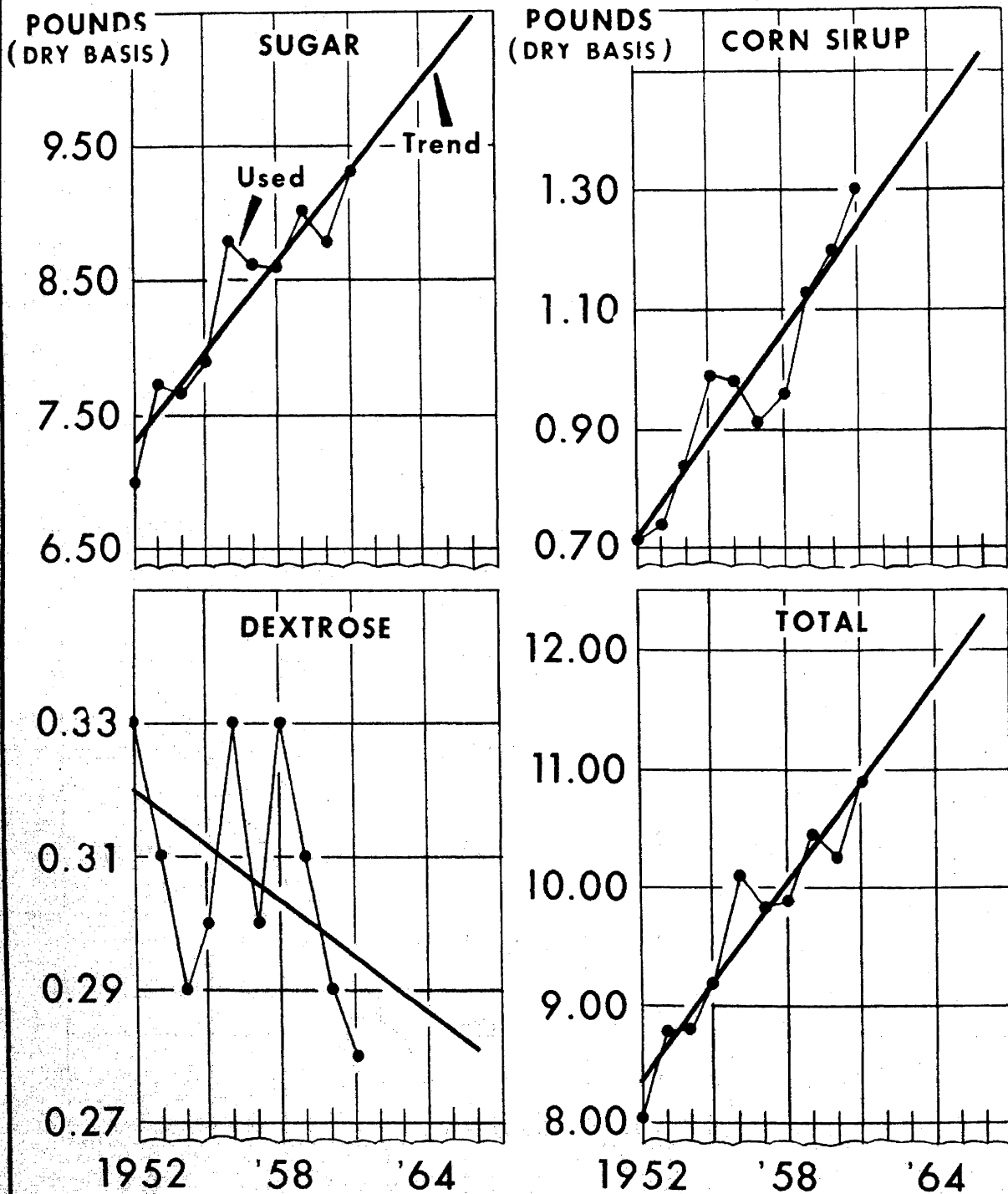


Figure 2

Table 5.--Use of sugar and dextrose by the canning industry, by years and geographic areas, 1952-1961 1/

Sweetener and year	New England	Middle Atlantic	North Central	South	West	United States
	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons
Sugar (refined):						
1952.....	23	106	105	88	226	548
1953.....	26	121	112	100	257	616
1954.....	25	130	123	102	242	622
1955.....	28	136	126	98	264	652
1956.....	24	153	155	116	291	729
1957.....	23	149	153	124	288	737
1958.....	25	148	156	142	280	751
1959.....	27	155	168	144	304	798
1960.....	25	144	180	145	296	790
1961.....	28	168	228	133	298	855
Dextrose (dry basis):						
1952.....	0.3	3.5	4.4	5.2	12.5	25.9
1953.....	.2	4.0	4.1	6.5	10.7	25.5
1954.....	.3	4.1	3.7	6.8	9.3	24.2
1955.....	.2	3.9	4.5	6.1	9.9	24.6
1956.....	.2	4.5	5.7	7.7	10.2	28.3
1957.....	.2	4.1	6.4	7.5	8.2	26.4
1958.....	.2	4.7	7.6	7.5	9.2	29.2
1959.....	.2	3.7	8.1	6.9	8.0	26.9
1960.....	.3	3.8	8.1	6.5	8.2	26.9
1961.....	.3	4.2	6.8	6.7	7.6	25.6

1/ Area boundaries shown in figure 3.

Sugar Reports, Sugar Div., Agriculture Stabilization and Conservation Service, U. S. Dept. Agr.

ANNUAL AVERAGE RATE OF CHANGE IN QUANTITIES USED

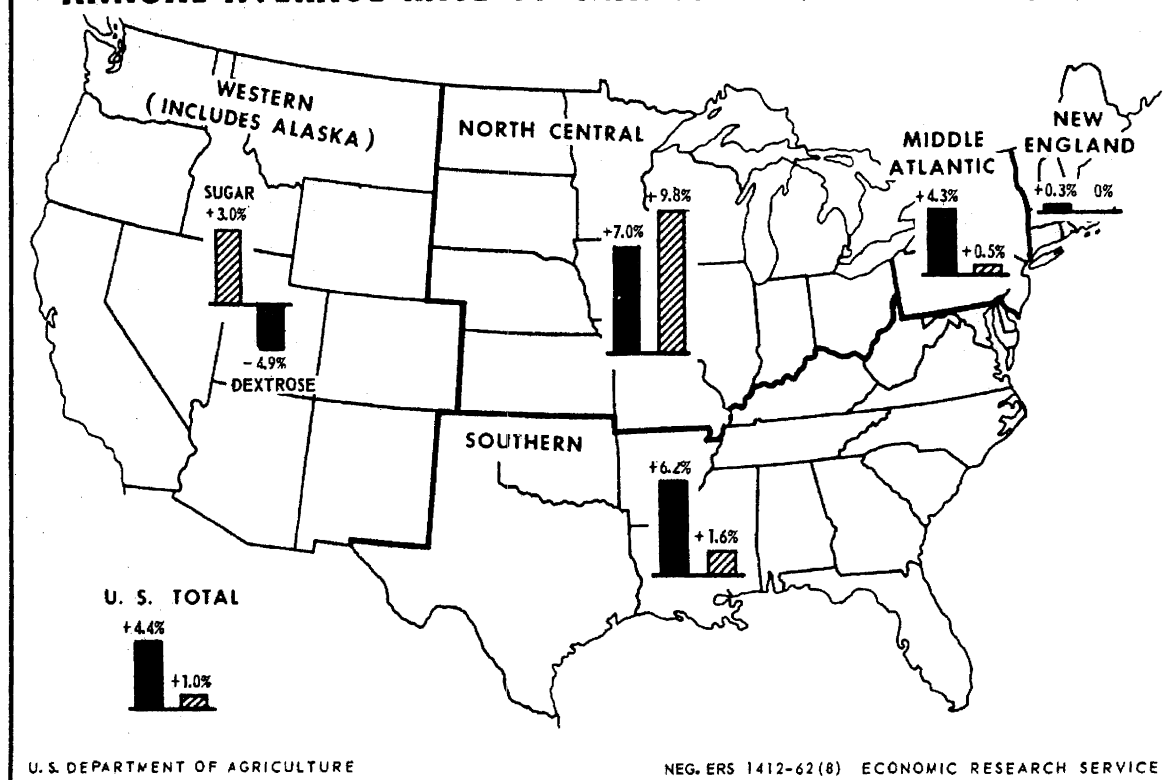


Figure 3

Canned Fruits

Regulations for canned fruits ordinarily specify 10 different packing media which may be used at the option of the canner. Two of these, water and the natural juice of the fruit being packed, contain no added sweetener. The remaining media are designated as slightly sweetened, light sirup, heavy sirup, or extra heavy sirup. Each of these may be made with water or the natural juice of the fruit.

The distinctions among the sweetened sirups used are stated in the Food and Drug regulations in terms of ranges in degrees Brix. ^{4/} These ranges are somewhat different for different fruits. The details for 8 fruits are shown in table 6. Regulations provide that Brix determinations of sirup classifications be made not less than 15 days after the fruit is canned. This length of time is considered necessary to stabilize the relationship between the soluble solids in the fruit and those in the added sirup.

Except for fruits packed with no added sweetener (water or natural fruit juice), the proportion of solids in the sirup as added is greater than that in the fruit. Consequently, the Brix of the sirup, after stabilization with the fruit in the can, is lower than in the sirup as added. This means that to obtain a given Brix in the final product, it is necessary to use sufficient sweetener to make the Brix of the sirup when canned

^{4/} The Brix hydrometer scale is an approximate measure of the density, or percent solids, in the sirup.

Table 6.--Range in sweetener content by type of sirup in canned fruits
(Degrees Brix)

Fruits	Slightly sweetened	Light	Heavy	Extra heavy
Peaches.....	Under 14	14 to 18.9	19 to 23.9	24 to 34.9
Apricots.....	Under 16	16 to 20.9	21 to 24.9	25 to 39.9
Pears.....	Under 14	14 to 17.9	18 to 21.9	22 to 34.9
Sweet cherries.....	Under 16	16 to 19.9	20 to 24.9	25 to 34.9
Sour red cherries..	Under 18	18 to 21.9	22 to 27.9	28 to 44.9
Fruit cocktail.....	---	14 to 17.9	18 to 21.9	22 to 34.9
Pineapple.....	---	14 to 17.9	18 to 21.9	22 to 34.9
Figs.....	---	16 to 20.9	21 to 24.9	25 to 34.9

Food and Drug Administration, Department of Health, Education and Welfare.

greater than that desired in the stabilized sirup. The difference between the "put-in" and the "cut-out" Brix varies with the fruit being canned, the fruit-sirup ratio, and the desired density of the cut-out sirup. The quantity of sweetener needed to obtain a cut-out sirup of the desired Brix is somewhat smaller if natural fruit juice, rather than water, is used as the liquid ingredient because of the solids present in the natural fruit juice.

Sweeteners Permitted in Canned Fruits

Sweeteners which may be used in canned fruits (under the regulations of the Food and Drug Administration) include sugar, invert sugar sirup, dextrose, corn sirup, dried corn sirup, glucose sirup, and dried glucose sirup. In most canned products, noncaloric sweeteners also may be used. These include saccharin, sodium saccharin, calcium cyclamate, sodium cyclamate, or any combination of two or more of these. Regulations permit sirups made with noncaloric sweeteners to be thickened with pectin.

For all canned fruits, sugar or invert sugar sirup may be used as the sole sweetening agent. Mixtures of dextrose with sugar or invert sugar sirup may be used. In most cases, the weight of the dextrose solids may not exceed one-third of the total weight of solids in the sweeteners used.

Corn sirup or glucose sirup ^{5/} may also be used in combination with sugar or invert sugar sirup, but the weight of the solids in the corn or glucose sirup must not exceed one-fourth the total weight of solids in the sweeteners used.

Mixtures of dextrose and corn or glucose sirup with sugar or invert sugar sirup are permitted. In such cases, the maximum proportion of the weight of the solids in the total sweetener, which may be supplied by dextrose plus corn or glucose sirup, varies from one-fourth to one-third. If the mixture of dextrose and corn or glucose sirup is mostly dextrose, the maximum limit approaches one-third; if the mixture is mostly corn or glucose sirup, the upper limit approaches one-fourth.

^{5/} Corn sirup is defined in the regulations as a product obtained from cornstarch. Glucose sirup is a product obtained from any edible starch.

Frozen Fruits

The Food and Drug Administration has established no regulations with respect to the use of sweeteners in frozen fruits; some were proposed years ago but have not yet been adopted.

Jams, Jellies, and Preserves

These products may be sweetened with sugar or dextrose or any combination of them. Corn sirup or glucose sirup, either liquid or solid, may be used in any combination or with any combination of sugar and dextrose provided the solids in the sirup do not exceed one-fourth the weight of solids of the combined sweeteners.

Honey, with certain limitations, may also be used in the manufacture of fruit butters.

Canned Vegetables

Most canned vegetables may be prepared with sugar or dextrose without specific limitations, although the amounts used in actual practice are likely to be small. The use of corn sirup or glucose sirup is not permitted.

No standards have been established on the use of sweeteners in frozen vegetables.

INDUSTRY PRACTICES IN THE USE OF SWEETENERS

A sampling of firms engaged in canning, freezing, or otherwise preserving a wide variety of fruits and vegetables in various sections of the United States indicates that the regulations of the Food and Drug Administration are frequently a decisive factor in determining the relative quantities of the different types of sweeteners the industry will use, particularly in canned fruits and vegetables. About half the firms interviewed which produced canned fruits indicated that they were using the maximum proportion of dextrose or corn sirup, or a combination of the two that is allowed.

Some canners indicated that they would use more corn sirup in certain products if regulations permitted. Others reported that the need to maintain quality acceptable to their customers would prevent any substantial or rapid change in the proportions of the sweeteners used in many products even if the regulations were changed. This applied particularly to the substitution of dextrose or corn sirup for sugar; although, in a few cases, canners reported that the substitution of sugar for dextrose would have undesirable effects on quality or would be contrary to the desires of some of their customers.

However, as shown earlier, the canning industry's use of corn sirup has been increasing about 50 percent faster than that of sugar. Many canners indicated that the lower price of corn sirup had been an important factor in their decision to use more corn sirup and relatively less sugar since 1952. The price differential between the two products has increased substantially since then as shown in table 7. Probably few, if any, canners ever paid exactly these prices. Nevertheless, the trend in price differentials shown in the table indicates that the price advantage of using corn sirup widened by over 80 percent in 10 years. During the same period, the price of corn--the raw material from which corn sirup is manufactured--decreased about 29 percent.

Table 7.--Trends in the prices of sugar, corn sirup, and corn, 1952-1961

Year	Refined sugar, wholesale, New York	Corn sirup, drums, in carlots, New York	Differential- sugar minus corn sirup	Corn--season average price received by farmers
	Dollars per 100 pounds	Dollars per 100 pounds	Dollars per 100 pounds	Dollars per bushel
1952.....	8.45	7.37	1.08	1.52
1953.....	8.55	7.32	1.23	1.48
1954.....	8.55	7.32	1.23	1.43
1955.....	8.42	7.25	1.17	1.35
1956.....	8.59	7.15	1.44	1.21
1957.....	8.97	7.36	1.61	1.12
1958.....	9.10	7.37	1.73	1.12
1959.....	9.14	7.31	1.83	1.04
1960.....	9.25	7.32	1.93	1.00
1961.....	9.21	7.23	1.98	1.08

The Sugar Situation, Econ. Res. Serv., and Stat. Rptg. Serv., U. S. Dept. Agr.

A number of canners using corn sirup also indicated that the quality of sirup available to them seemed to have improved in recent years or, at least, to be more suitable to their needs. Producers of corn sirups have, for many years, offered a variety of types for sale. Perhaps the most important difference has been in the degree of conversion of the starch into dextrose and other saccharides.^{6/} This is commonly specified in the trade as DE, or dextrose equivalent. Production to more exact specifications in this and other respects probably has improved the competitive position of corn sirup.

Use of Noncaloric Sweeteners

About 10 percent of the canners interviewed used one or more noncaloric sweeteners--almost entirely in the production of canned fruits for dietetic purposes. All of the canners using noncaloric sweeteners also used sugar, dextrose, or corn sirup, or combinations of these. However, there was no mixing of noncaloric sweeteners with other types. Most of the canners using noncaloric sweeteners used only calcium cyclamate, although some use of sodium cyclamate and saccharin also was reported.

From the point of view of the canners, the noncaloric sweeteners are used to manufacture products having markets largely separate from those in which products sweetened with sugar or corn sweeteners are sold. Consequently, questions of comparative prices, convenience, and quality had little influence on canners' decisions with reference to their use.

Of course, a certain amount of competition does exist at the retail level. Many consumers who purchase products prepared with noncaloric sweeteners doubtless do so for medical reasons which more or less preclude the use of products sweetened with sugar or with dextrose or corn sirup. However, some part of these products is purchased and used by people who have a choice among types of sweeteners, although beliefs concerning weight control and health may be important factors in

^{6/} None of these are sucrose (sugar).

determining the choice made. No information is available concerning the proportions of canned products prepared with noncaloric sweeteners which are purchased for strictly medical or for other reasons.

Forms of Sweeteners Used

Sugar is the only sweetener used by about one-fourth of the canners interviewed. Two used only dextrose. The remainder, nearly three-fourths of the total, used some combination of sugar with corn sirup, dextrose, or a mixture of sirup and dextrose.

Bagged sugar is still used in about one-fourth of the plants, although canners reported a definite trend in the direction of using more liquid and dry bulk sugar. Factors which make it profitable for certain canners to receive part or all their sugar in bags include:

1. The small quantity of sugar used by certain plants. Many small plants with short seasonal operations use only a small quantity of sugar. This can be transported to the plant in bags, stored there, and used, at less cost than in liquid or bulk. More expensive equipment is needed to handle sugar in liquid or bulk form.

2. The opportunity to obtain a return load for delivery trucks under circumstances which result in lower costs to the canner. Canners who make deliveries of their products in owned or leased trucks sometimes can reduce the cost of transporting sugar to their plants by using the same delivery trucks to haul sugar as a return load. This procedure is not feasible for liquid or bulk sugars because they require special types of trucks.

3. Preference for brands of sugar available only in bags. Imported sugar in refined or partly refined form ordinarily is available only in bags. This is also true of refined sugar shipped to the mainland from Hawaii and Puerto Rico. Sugar in these forms usually sells at somewhat lower prices than sugar refined in continental United States and, for this reason, is preferred by certain canners. Only a few cane sugar mills in continental United States make partly refined sugar available in bags.

4. The need for reserve supplies at the beginning and end of seasonal operations and for emergencies. About one-third of the plants using sugar in liquid or bulk form also use some bagged. One reason, particularly for plants using liquid sugar, is to insure a supply adequate for completing the seasonal operation without having any liquid sugar left over. Bagged sugar can be stored successfully from one season to the next; liquid sugar cannot. A supply of bagged sugar also is handy for meeting minor emergencies, such as a delay in the arrival of a delivery truck.

5. The need for "canner's" grade sugar in some of the products manufactured. Another reason for using some bagged sugar is that one or more products require sugar of a special quality, usually designated as "canner's" grade. The National Canners Association has established a set of standards and methods of testing samples of sugar for the presence of bacteria most likely to cause spoilage in nonacid canned foods, such as sweetpotatoes. Certain types of bacteria are not readily destroyed by the heat used in the canning process. The sugar used, therefore, must meet unusually strict standards with respect to the number of these types present. These are the standards commonly referred to when canner's grade sugar is specified.

Convenience, sanitation, and ease of handling are the major reasons for the growing use of liquid sugar in canning plants. Less manual handling is required than

when bagged sugar is used. Also, the liquid is kept in closed containers where it is less subject to contamination with foreign matter than if stored in dry form. Liquid sugar, however, is not suitable for use in preparing most frozen fruits and vegetables, which largely excludes its use in this important segment of the industry.

The use of dry sugar in bulk, either as the sole form of sweetener or in combination with other forms, was reported by about half the canners interviewed. Using bulk sugar has some of the advantages of using liquid sugar and, in addition, eliminates the expense of transporting a considerable quantity of water, which is necessary when liquid sugar is used. Because of the cost of transporting the water in liquid sugar, plants situated at great distances from sources of supply are likely to find it cheaper to buy their sugar in dry bulk rather than in liquid form.

All the canners interviewed who purchased either corn sirup or dextrose, except two, used these products in combination with sugar. About one-third of the canners interviewed used sugar and corn sirup, one-fourth used sugar and dextrose, and one-seventh used all three sweeteners. A few canners purchased a blend of liquid sugar and corn sirup, and others expressed an interest in purchasing a blend rather than preparing the blend in their own plant. The use of a purchased blend reduces somewhat the equipment and labor requirements in the cannery and may also result in a more uniform mixture of the sweetener.

COST OF SWEETENERS RELATIVE TO OTHER RAW MATERIALS USED BY CANNERS

Sugar and other sweeteners are part of the raw materials purchased by canners. The proportion, by weight, which sweeteners are of the total raw material which canners use varies from zero for certain products to about three-fourths for others. Many canned vegetables contain no added sweetener. Other products, such as most jams, jellies, and preserves, contain 50 percent or more of added sweetener. Frozen fruits usually have from 15 to 25 percent of sweetener added, mostly sugar (the most common figure being 20 percent).

The cost of sweeteners, likewise, form a highly variable proportion of the share of the total cost of the raw materials used. For canned peaches, most canners reported it as varying from about 25 to 35 percent. The cost of sweeteners for cranberries was usually about one-third of the total. It was one-half or more for various types of jams, jellies, and preserves. For frozen fruits, the proportion varied from about 10 to 60 percent.

There are several reasons for the wide variation in the relation of sweetener cost to total raw material cost. In the case of canned fruits, the density of packing media may range from water to extra heavy sirup, although most fruit is prepared in the middle classifications with either light or heavy sirup. The quantity of sweetener added to produce the heavier sirups is considerably greater than that needed for the light sirups, as indicated by the Brix specifications in table 6. However, it is impossible to calculate exactly the difference in the quantity of sweetener which must be added because of variations in the sweetness of natural fruit.

The cost of the fresh fruit used by the canning industry varies considerably with the time and place of purchase and the kind and quality of the fruit. Price variations of almost all fruit purchased by processors have been greater than those for sugar or other sweeteners. Under the United States quota system, sugar prices have been unusually stable in recent years, as compared with the prices of most other products.

Quality considerations greatly limit the extent of changes canners are able to make in the quantity of sweeteners used. As a result, the quantity of sweeteners purchased is affected very slightly by moderate changes in their price, such as have occurred in recent years. Several purchasing agents for canners indicated that they are more concerned with purchasing sweeteners at prices no higher than those paid by their competitors than by changes in the general level of sugar prices which affect everyone.

Price changes which affect all producers of a commodity more or less equally often can be offset by changes in the price of the final product. In most cases, a small percentage change in the price of the finished product is sufficient to offset the change in sweetener cost and may hardly be noticed by buyers or sellers because of other factors affecting prices more or less simultaneously.

If, however, an individual canner should pay a higher price for any sweetener, he would not be in a position to adjust the price of his product to take care of the increased cost. While sweetener prices have been less variable than those of many other agricultural commodities in recent years, changes have been sufficiently large and frequent to cause most canners to give careful attention to their buying practices.

Large companies, particularly those operating a number of plants, are likely to have one or more specialists who devote more or less continuous attention to the market for all sweeteners and who attempt to make purchases at the most favorable times and on the most favorable terms. Deliveries of sweeteners so purchased may be made at intervals extending for several months after purchase agreements are made. Other companies, usually of small or medium size, may rely on a single supplier for one or more of the sweeteners used, hoping that the prices they pay will be, at least, no higher than the average for the season and their location. The smallest companies use such a small volume of sweeteners that they merely make purchases as needed and from local dealers.

ECONOMIC IMPLICATIONS

Current trends in the use of sweeteners in the canning industry appear considerably more favorable to producers of corn sirup than to the sugar industry. The trend is away from home canning, where practically no corn sweeteners are used, and toward commercial operations, where the proportion of corn sirup used has been increasing rather rapidly. This trend has restricted the increase in the use of sugar in the preservation of fruits and vegetables by canning.

Canners reported plans for further increases in the use of corn sirup, which indicates that the trend will continue toward less sugar and more corn sirup in sweeteners used in canning. Present regulations of the Food and Drug Administration place an upper limit on the proportion of corn sirup which may be included in the sweeteners used in canning various products. A number of canners, however, indicated that, if permitted, they would use a larger proportion of corn sirup in sweetening one or more of their products. A change in Government regulations permitting the use of corn sirup probably would be followed by considerable further increase in the use of corn sirup, particularly under present price relationships.

It is also possible that consumers will develop a preference for such products as they gradually become accustomed to the taste resulting from additional quantities of corn sirup in various canned products. If so, a reduction in the price differential between sugar and corn sirup might not be entirely effective in restoring the earlier proportions of sugar and corn sirup used by the canning industry.